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A.D. 1881, *3rd February.* N° 458.

Brewing.

LETTERS PATENT to Alexandre Manbré, of No. 4, South Street, Finsbury, in the County of Middlesex, for an Invention of "IMPROVEMENTS IN BREWING."

PROVISIONAL SPECIFICATION left by the said Alexandre Manbré at the Office of the Commissioners of Patents on the 3rd February 1881.

ALEXANDRE MANBRÉ, of No. 4, South Street, Finsbury, in the County of Middlesex. "IMPROVEMENTS IN BREWING."

My Invention relates to an improved process of producing or manufacturing beers, such as ales, stout, porter, and like fermented liquors, in which the materials employed are treated in a manner that produces much better results than have hitherto been obtained from their use, and the brewed liquors are of much superior character as compared with those hitherto produced by the ordinary processes.

Hitherto it has been the practice in the production of beers, such as ales, stout, porter, and like fermented liquors, to use either malt alone or a mixture of malt and sugar, the malt being the product of germinated barley, known in the trade as pale amber, brown, and roasted malt, and the sugar being known in the trade as raw sugar, inverted sugar, glucose, saccharine, saccharum, caramel, or burnt sugar, and the like. The process now in use consists in crushing the malt and subjecting the meal and husk thus obtained to the process of saccharification (meaning thereby conversion into saccharine products) by mashing at a temperature varying from about 140 to 200 degrees Fahrenheit, and the worts thus produced are then boiled with hops, cooled, and fermented; when sugar or caramel is used, it is generally added either in its solid form or dissolved in water to the worts either in the under back or in the boiler.

A few attempts have been made to use malted "big" (a term applied by brewers to a particular kind of barley) and maize and oats, but the results were so unsatisfactory that the attempts were not persevered in except in the use of "big" only, but this in only one or two counties of the kingdom. I am aware that attempts have been made to use, in producing beers or like fermented liquors, various materials, such as wheat, potato, oats, barley, rice, and maize, more or less in a raw state in conjunction with malt, but the processes proposed to be used and the results obtained have not been successful. The beers produced have been found to contain in solution acid and empyreumatic substances, and an access of nitrogenous

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matters chiefly arising from the husk of the malt and raw material used, the acrid and empyreumatic substances imparting to the beer a bitter and nauseous taste, and the excess of nitrogenous matters subsequently reacting on the alcohol contained in the beer and transforming it into acetic acid.

Now I have found that by employing my improved process of treating the materials employed, and selecting the proper agents, the difficulties hitherto experienced may be obviated. In carrying out my process I proceed as follows:— I treat the malt flour so as to obtain a better saccharification and purify the worts obtained separately, and I subject the farinaceous and amylaceous parts contained in the following substances, namely, maize, rice, barley, "big," oats, wheat, darn, millet, sago, mandioca, potato, arrowroot, and the like, separately to the processes of treatment, saccharification, and purification hereinafter described. By using the saccharified and purified worts obtained from malt and from any one of the above named substances, or from a mixture of several of them respectively, as may be found most convenient, jointly with the purified malt worts in the manner hereinafter more particularly set forth, I am enabled to produce beers greatly superior in purity, brilliancy, delicacy of flavor, and keeping properties, and at a much lower cost of production as compared with beers produced from malt alone or from a mixture of malt and sugar as has hitherto been done.

My improved process may be conveniently divided into two parts.

The first part has for object the saccharification of the malt separately, and in one operation or mashing and the purification of the worts obtained therefrom. For that purpose I treat the malt in the following manner:—

1. I grind the malt into flour and separate by the usual known means the husk or bran therefrom.

2. I subject the flour free from husk, diluted in the required quantity of water according to the strength of the beer it is intended to produce, to the action of reagents, such as those hereinafter mentioned, for the purpose of obtaining a sounder saccharification, and subject the mixture to the action of heat varying from 150 to 175 degrees Fahrenheit, according to the proportion of dextrine and fermentable saccharine it is desired to obtain.

3. I purify the saccharified worts thus obtained by neutralizing the deleterious matters they contain, and which otherwise would affect the quality, flavour, and keeping properties of the beer, in the manner hereinafter described, and most advantageously by employing the reagents particularly referred to.

4. I boil the purified worts thus obtained with hops as usual, and then cool and convey them into the fermenting vessel to be mixed and fermented together with the purified worts produced from any one of the above named substances, or from a mixture of several of them as may be found most convenient.

The second part of my process has for object the saccharification in one operation or mashing of the amylaceous or starchy part contained in the above named substances either by treating any one of them separately or a mixture of several of them, as may be found most convenient, and the purification of the worts thus produced which I obtain in the following manner, taking the use of maize as an illustration:—

1. I separate from the maize by the most convenient processes now in use the farinaceous and amylaceous parts of the grains, rejecting the husks and similar parts.

2. I subject the farina or flour or separated part thus obtained, diluted in a sufficient quantity of water (according to the strength of the beer it is intended to produce), to the action of reagents, such as those hereinafter mentioned, for the purpose of freeing the amylaceous part from nitrogenous and other foreign bodies with which it was combined and obtaining it in a soluble form.

3. I subject the amylaceous solution thus obtained to the action of suitable re agents hereinafter described and to a heat varying from 250 to 300 degrees Fahrenheit, according to the proportion of dextrine and fermentable saccharine it is desired to obtain. It is important to notice that the use of these high tempera-

tures, though unusual in the ordinary brewing process are necessary because at lower temperatures the results would be less successful.

4. I purify the saccharified worts thus obtained by neutralizing (by means of agents such as are hereinafter mentioned) the deleterious matters they contain, and which otherwise would affect the quality, flavour, and keeping properties of the beer.

5. I boil the purified worts thus obtained with hops and cool them in the usual way; or if preferred, as the worts require no boiling, they may be cooled and conveyed direct into the fermenting vessel to be mixed and fermented together with the worts produced from the malt as above stated.

I have found by experience that in some cases any one or a mixture of several of the above named amylaceous substances may be used as a substitute for malt or for malt and sugar for the purpose of producing the required amount of dextrine and fermentable saccharine, a small portion of malt flour (varying from 2 to 10 per cent. of the amount of the amylaceous substances used) being employed, but merely for the purpose of imparting the malt flavor to the beer. The process I employ in such cases is the same as that described in the second part aforesaid, with the exception that when the worts are subjected to the process of purification I add to such worts the requisite quantity of hops and malt flour for flavouring the worts as may be found desirable. I then strain and cool the flavoured worts thus obtained and ferment as usual.

The malt, flour, and hops, or a portion thereof, can advantageously be added to the starch solution and be subjected to the action of heat and reagents during the process of saccharification, or they may also in like proportion be added to the worts in the fermenting vessel, in which case a larger proportion of yeast and a finer flavoured beer are obtained.

From the foregoing description of the nature and objects of my Invention, it will be understood by those conversant with the art of brewing that the essential features of my improved process of producing ale, stout, porter, or like fermenting liquors, and which, as used by me are new, are directed to produce the following important results:—

A. To effect the proper saccharification of the malt and the maize respectively, which is to be done separately because, owing to the different nature of the starch contained therein, a sound and complete saccharification will in each case require different temperatures, the malt requiring a temperature of not exceeding 190° Fahrenheit, whilst the maize requires a temperature of not less than 250° Fahrenheit.

B. To purify the malt worts and maize worts separately, which the different nature of the noxious matters therein contained render necessary, so that they may be afterwards mixed in the fermenting vessel, whereas if the maize, after having been subjected to a preliminary process of disintegration, is mixed with the malt, and conjointly subjected to the usual process of mashing for effecting the saccharification at a temperature varying from 140 to 200 degrees Fahrenheit, and the worts thus obtained are subjected to boiling with hops, cooling, and fermenting as is usually the case, the results will be found unsuccessful.

C. To enable maize or other amylaceous substances to be efficiently used as substitutes for malt or malt and sugar for the production of dextrine and fermentable saccharine, using a small portion of malt flour only for the purpose of flavouring the beer, whereas by the processes now in use on more than from 20 to 33 per cent. of maize to 100 parts of malt can be used with any success.

D. To use chemical agents, hereinafter mentioned, for the purposes, respectively, of effecting proper neutralization, and for imparting to stout, porter, and other colored beer, the requisite dark color and particular flavor it is desirable for them to possess.

E. To produce ale, stout, porter, and like fermenting liquors, of much superior quality at a cost of production of nearly one half the cost of beer as made from malt or from malt and sugar by the processes hitherto adopted.

Having now described the main features of my improvements, I will proceed to describe the manner in which I carry into effect my improved process, and in order that it may be better understood I will take as an illustration,—

1. The use of 20 bushels of malt of 42 lbs. each (excise standard weight), or their equivalent of malt flour, for one operation or conversion, to yield 10 barrels of beer of average gravity of 20·5 by Dring and Fage's saccharometer, equal to 1057″ (Exise standard density).

2. The use of 20 bushels of maize of 42 lbs. each, or their equivalent of maize flour, for one operation or conversion, to yield likewise 10 barrels of beer of the gravity and density aforesaid.

And as by my process I can make one operation or conversion in one hour, it will be seen that by making ten conversions in one day, the production of beer will be 100 barrels, being equal to a twenty five quarters plant.

The saccharifying apparatus and other appliances which I find may be used with advantage are of the kind usually employed in brewing processes, and may be generally described as consisting of,—

A hopper or flour dressed receiver.

A mixing or diluting vat furnished with a stirrer and steam coil.

A saccharifying apparatus furnished with stirrer and steam coil, steam guage, inlet and outlet steam cock, and other necessary accessories.

A purifying vat also furnished with stirrer and steam coil.

A strainer or filtering medium, and

A collecting vat.

The manner in which I conduct the conversion is as follows:—

First. Relating to the saccharification of malt.

The 20 bushels of malt are ground into flour, and the husk or bran separated therefrom; the flour thus obtained is put into the hopper.

I next put in the mixing vat, the requisite quantity of water (about 450 gallons) for obtaining ten barrels of beer, which water is heated by means of steam through the coil; I then add to the water about two pounds and a half of phosphate of lime and about half a pound of sulphuric acid, diluted in about one gallon of water, putting at the same time the stirrer in motion for mixing the said admixture. When the temperature of the admixture has risen to 100° Fahrenheit, the malt flour is then gradually poured in and well mixed, the stirring and heating being continued until the temperature has risen to from 150° to 175° Fahrenheit, according to the proportion of dextrine and fermentable saccharine it is desired to obtain. The worts are then drawn off and conveyed into the purifying vat, where the process of neutralizing the excess of acid and nitrogenous matters, as well as the acrid and empyreumatic substances they contain, is effected; for that purpose I add to the worts a compound of about one pound of oleate of soda and about two pounds of charcoal, which are thoroughly mixed with the said worts during about half an hour, when the neutralization will generally be found to be complete.

It is to be noted that the most efficacious and convenient agents that can be used for effecting the required neutralization, which is a very important part of my process, are those above mentioned, and the use of oleate of soda is new for the purpose, but, as will be understood by experienced brewers, other neutralizing agents may be used. The best form of oleate is that obtained by combining soda or soda and lime with almond oil or pistachio oil, or olive oil, or arachidic oil.

The purified worts are conveyed through the strainer or any other suitable filtering medium into the pan or boiler to be boiled with the requisite proportion of hops as usual. The hopped worts are then cooled and conveyed into the collecting vat or fermenting vessel to be mixed and fermented together with the maize worts.

Second. Relating to the saccharification of maize. The 20 bushels of maize are ground into flour and the husk or bran removed therefrom, the flour thus obtained is put into the hopper.

Next I put in the mixing vat the requisite quantity of water (about 450 gallons) for obtaining ten barrels of beer, which water is heated by means of steam through the coil. I then add to the water about two pounds of phosphate of lime, about two pounds of sulphuric acid, and about two pounds of oxalic acid, putting at the same time the stirrer in motion for mixing the said admixture. When the temperature has risen to 100 degrees Fahrenheit, the maize flour is then gradually poured in and well mixed, the stirring and heating being continued until the temperature has risen to 180 degrees Fahrenheit. I then add to the admixture a compound of about five pounds of oxalic acid, and about five pounds of charcoal, maintaining the heating and stirring meanwhile.

The whole of the admixture is then introduced into the converting apparatus, the inlet cock is then shut and the steam put on to raise the temperature in the converter up to from 250 degrees to 300 degrees Fahrenheit (equivalent to from 40 to 80 pounds pressure to the square inch) according to the proportion of dextrine and fermentable saccharine it is desired to obtain. The saccharified solution called wort is then drawn off into the purifying vat for the purpose of neutralizing the excess of acids and nitrogenous matters, as well as the acrid and empyreumatic substances they contain; to that effect I add to the worts about ten pounds of carbonate of lime diluted in about two gallons of water, and a compound of about one pound of oleate of soda, and about two pounds of charcoal, which are thoroughly mixed with the said worts for about half an hour, when the neutralization will be found effected. The purified worts are then conveyed through the strainer or other suitable filtering medium into the pan or boiler to be boiled with the requisite proportion of hops as usual.

The hopped worts are then cooled and conveyed into the collecting or fermenting vessel to be mixed and fermented together with the malt worts.

I will here observe that the malt worts and the maize worts can be collected into the pan or boiler to be boiled together with the requisite hops and then cooled and fermented.

Sometimes it is the custom to macerate and infuse the hops; in that case the extract or produce of such maceration and infusion can be added to the worts either in the boiler, or cooler, or fermenting vessell.

Third. Relating to the use of maize as a substitute for malt and for malt and sugar.

The 20 bushels of maize are ground into flour and the husk or bran removed therefrom, the flour thus obtained is put into the hopper.

Next I put in the mixing vat the requisite quantity of water for obtaining ten barrels of beer (about 450 gallons) which water is heated by means of steam through the coil; I then add to the water about two pounds of phosphate of lime, about two pounds of sulphuric acid, and about two pounds of oxalic acid, putting at the same time the stirrer in motion for mixing the said admixture. When the temperature has risen to 100 degrees Fahrenheit, the maize flour is then gradually poured in, to which I add about 28 pounds of malt flour, and about five pounds of well pulverized hops; the whole is well mixed, the stirring and heating being continued until the temperature has risen to 180 degrees Fahrenheit; I then add to the admixture a compound of about five pounds of oxalic acid and about five pounds of charcoal, maintaining the stirring and heating meanwhile. The whole of the admixture is then introduced into the converting apparatus; the inlet cock is then shut off and the steam is put on so as to raise the temperature in the converter up to from 250 degrees to 300 degrees Fahrenheit, equivalent to from 40 to 80 pounds pressure to the square inch, according to the proportion of dextrine and fermentable saccharine it is desired to obtain.

The saccharified solution or wort is then drawn off into the purifying vat and treated as above described for the saccharification of maize flour, *videlicet*, by neutralizing the excess of acids, nitrogenous matter, and acrid and empyreumatic substances, then straining the purified worts, cooling, and conveying them into the fermenting vessel.

For producing stout, porter, and other more or less colored beer, I proceed in the same manner as described in part three aforesaid, with the exception that I add to the mixture (at the same time with the compound of about five pounds of oxalic acid and about five pounds of charcoal) about from one to two pounds of oxide of potassium diluted in about one gallon of water, and about five pounds of pulverized roasted malt for the purpose of imparting the desired flavor and color to the beer.

I would observe that by introducing the malt flour, hops, and roasted malt in the converter, and subjecting them to the joint action of the high temperature of from 250 degrees to 300 degrees Fahrenheit, and the reagents therein contained, all the flavouring constituents of the malt, hops, and roasted malt are thoroughly extracted and imparted to the worts, thus requiring a much less quantity of malt, hops, and roasted malt to obtain the same intensity of flavor.

I would also observe that the proportion of malt flour, hops, and roasted malt can advantageously be used in the following manner:—One half in the converter during the process of saccharification, and the other half in the purifying vat during the process of neutralization. Or one third in the converter, one third in the purifying vat, and one third mixed with the worts in the fermenting vessel.

In any case by using from one to two pounds of malt flour for every barrel of worts in the fermenting vessel, a better and sounder fermentation and a larger production of yeast will be obtained.

SPECIFICATION in pursuance of the conditions of the Letters Patent filed by the said Alexandre Manbré in the Great Seal Patent Office on the 3rd August 1881.

ALEXANDRE MANBRÉ, of No. 4, South Street, Finsbury, in the County of Middlesex. "IMPROVEMENTS IN BREWING."

My Invention relates to an improved process of producing or manufacturing beers, such as ales, stout, porter, and like fermented liquors, in which the materials employed are treated in a manner that produces much better results than have hitherto been obtained from their use, and the brewed liquors are of much superior character as compared with those hitherto produced by the ordinary processes.

Hitherto it has been the practice in the production of beers, such as ales, stout, porter, and like fermented liquors, to use either malt alone or a mixture of malt and sugar, the malt being the product of germinated barley, known in the trade as pale amber, brown, and roasted malt, and the sugar being known in the trade as raw sugar, inverted sugar, glucose, saccharine, saccharum, caramel or burnt sugar, and the like. The process now ordinarily in use consists in crushing the malt and subjecting the meal and husk thus obtained to the process of saccharification (meaning thereby conversion into saccharine products) by mashing at a temperature varying from about one hundred and forty to two hundred degrees Fahrenheit, and the worts thus produced are then boiled with hops, cooled, and fermented; when sugar or caramel is used it is generally added either in its solid form or dissolved in water to the worts either in the under back or in the boiler.

A few attempts have been made to use malted "big" (a term applied by brewers to a particular kind of barley), and maize, and oats, but the results were so unsatisfactory that the attempts were not persevered in, except in the use of "big" only, but this in only one or two counties of the kingdom. I am aware that attempts have been made to use in producing beers or like fermented liquors various materials, such as wheat, potato, oats, barley, rice, and maize, more or less in a raw state, in conjunction with malt, but the process proposed to be used and the results obtained have not been successful. The beers produced have been found to contain in solution acrid and empyreumatic substances and an excess of nitrogenous matters, chiefly arising from the husk of the malt and raw material used, the acrid and empyreumatic substances imparting to the beer a bitter and nauseous taste, and the excess of nitrogenous matters subsequently reacting on the alcohol contained in the beer and transforming it into acetic acid.

Now I have found that by employing my improved process of treating the materials employed, and selecting the proper agents, the difficulties hitherto experienced, as above mentioned, may be obviated. In carrying out my process I proceed as follows:—I treat the malt flour so as to obtain a better saccharification, and in particular I purify the worts obtained therefrom separately. I also subject the farinaceous and amylaceous parts contained in the following substances, namely, maize, rice, barley, big, oats, wheat, darn, millet, sago, mandioca, potatoe, arrowroot, and the like (hereinafter referred to as maize and the like), separately to the processes of treatment saccharification and purification hereinafter described. By using the saccharified and purified worts obtained from malt and from any one of the last named substances, or from a mixture of several of them respectively, as may be found most convenient, jointly with the purified malt worts in the manner hereinafter more particularly set forth, I am enabled to produce beers greatly superior in purity, brilliancy, delicacy of flavor and keeping properties, and at a much lower cost of production as compared with beers produced from malt alone or from a mixture of malt and sugar, as has hitherto been done.

My improved process may be conveniently divided into two parts.

The first part has for its object the saccharification of the malt, meaning thereby barley malt separately and in one operation or mashing, and also the purification of the wort obtained therefrom. For that purpose I treat the malt in the following manner :—

(*a.*) I grind the malt into flour and separate by the usual known means the husk or bran therefrom.

(*b.*) I subject the flour when freed from husk, and diluted in the required quantity of water, according to the strength of the beer it is intended to produce, to the action of chemical agents, such as those hereinafter mentioned, for the purpose of obtaining a sounder saccharification, and I then heat the mixture to a temperature varying from one hundred and fifty to one hundred and seventy five degrees Fahrenheit, according to the proportion of dextrine and fermentable saccharine it is desired to obtain.

(*c.*) I purify the saccharified wort thus obtained by neutralizing the deleterious matters it contains, and which otherwise would affect the quality, flavour, and keeping properties of the beer, in the manner hereinafter described, and most advantageously by employing chemical agents such as are hereinafter particularly referred to, that is to say,—

(*d.*) I boil the purified wort thus obtained with hops as usual, and then cool and convey it into the fermenting vessel to be fermented by itself if it is intended to make beer from malt alone, or I cause the purified malt wort to be mixed and fermented together with the purified wort produced from maize, rice, or the other before named like substances, or from a mixture of several of them, as may be found most convenient.

The second part of my Invention relates to my processes for effecting the saccharification and purification of worts obtained from maize and like substances. Taking the use of maize as an illustration,—

(*a.*) I separate from the maize (by any of the most convenient methods now in use), the farinaceous and anylacious parts of the grains, rejecting the husks and similar parts.

(*b.*) I subject the farina or flour or separated part thus obtained, diluted in a sufficient quantity of water (according to the strength of the beer it is intended to produce), to the action of chemical agents such as those hereinafter mentioned, for the purpose of freeing the amylaceous part from nitrogenous and other foreign bodies with which it was combined, and obtaining it in a soluble form. I then subject the amylaceous solution thus treated to a heat varying from two hundred and fifty to three hundred degrees Fahrenheit, according to the proportion of dextrine and fermentable saccharine it is desired to obtain. It is important to notice that the use of these high temperatures, though unusual in the ordinary brewing process, is very advantageous in my improved process, because at lower temperatures the results would be less successful.

(*c.*) I purify the saccharified worts thus obtained by neutralizing (by means of chemical agents such as are hereinafter mentioned), the deleterious matters they contain and which otherwise would affect the quality, flavour, and keeping properties of the beer.

(*d.*) I boil the purified worts thus obtained with hops and cool them in the usual way ; or if preferred (as the worts in many cases will require no boiling), they may be cooled and conveyed direct into the fermenting vessel to be mixed and fermented together with the worts produced from the malt as above stated.

I have found by experience that in some cases any one or a mixture of several of the above named amylaceous substances, being maize and the like, may be used when treated by my processes as substitutes for malt or for malt and sugar, and for the purpose of producing the required amount of dextrine and fermentable saccharine I employ a small portion of malt flour (varying from five to twenty per cent. of the amount of the amylaceous substances used), but merely for the purpose of imparting the required malt flavor to the beer. The process I employ in such cases is the same as that described in the second part aforesaid, with the exception that when the worts are subjected to the process of purification, I add to such worts the requisite quantity of hops and malt flour for flavoring the worts as may be found desirable. I then strain and cool the flavored worts thus obtained and ferment as usual.

The malt flour and hops or a portion thereof can advantageously be added to the starch solution and be subjected to the action of heat and chemical agents during the process of saccharification, or they may also in like proportions be added to the worts in the fermenting vessel, in which case a larger proportion of yeast and a finer flavoured beer are obtained.

In describing the manufacture of beer from malt and maize and the like substances (maize being taken as the type of the grain and starches above enumerated), according to my Invention I will take as an illustration,—

1. The use of twenty bushels of malt of forty two pounds each (Excise standard weight), or their equivalent of malt flour for one operation or conversion into wort so as to yield about ten barrels of beer of average gravity of 20·5, by Dring and Fage's sacchorometer, equal to 1057° Excise standard density.

2. The use of twenty bushels of maize of forty two pounds each or their equivalent of maize flour for one operation or conversion into wort so as to yield likewise about ten barrels of beer of the gravity and density aforesaid.

Now as by my process I can make one operation or conversion into wort properly saccharified in one hour, it will be seen that by making ten conversions in one day the production will be equivalent to the brewing of one hundred barrels of beer per day, being equal to a twenty five quarters plant.

The vessels and apparatuses which I make use of are (with the exception of the saccharifying apparatus), of the kind usually employed in brewing processes, and may be generally described as consisting of,—

A hopper or flour receiver.

A mixing or diluting vat, furnished with stirrer, steam coil, and outlet cock.

A close saccharifying apparatus, furnished with stirrer, steam coil, steam gauge, pyrometer, inlet and outlet cocks, &c.

A strainer or grain separator.

A purifying vessel.

A filter of any suitable kind, and

A collecting or boiling vessel.

The manner in which I conduct the conversion is as follows:—

First. Relating to the saccharification of the malt.

The twenty bushels of malt are ground into flour, and the husk or bran separated therefrom, the flour thus obtained is put into the feeding hopper.

I next put into the mixing vat or mashing tun the requisite quantity of water (about five hundred gallons) for obtaining ten barrels of beer, which water is heated by means of steam through an ordinary coil. I then add to the water about two pounds of phosphate of lime diluted in one gallon of water, and one pound of sulphuric acid likewise diluted in one gallon of water, putting at the same time the stirrer in motion for mixing the said mixture.

I give the quantities I have found it advisable to use, but it will be understood that they may be somewhat varied, and those proportions should be employed which will be found most beneficial, having regard to the ascertained quality and condition of the materials operated upon. Persons conversant with the subject matter will have no difficulty in making the requisite modifications of the quantities mentioned by me, so as in any given case to produce the results which are desired.

When the temperature of the mixture has risen to 100° Fahrenheit, the malt flour is gradually allowed to enter from the feeding hopper, and is well mixed, the stirring and heating being continued until the temperature has risen from 150° to 175° Fahrenheit, according to the proportion of dextrine and fermentable saccharine it is desired to obtain. The wort is then drawn off and passed through any suitable strainer to free it from the residuum or grains, and is conveyed into the purifying vessel in which the process of purification is effected by neutralizing the free acids, such as lactic, acetic, and ulmic acids, as well as the nitrogenous acrid and empyreumatic matters contained in the wort.

For this purpose I subject the malt wort to the action of oleate ~~of soda,~~ adding one pound of that material; and for the more effectual neutralization of the free acids, I mix with the oleate of soda half a pound of wood charcoal, and half a pound of pulverized animal charcoal. This compound I thoroughly mix with the wort during about half an hour, when the neutralization and purification will generally be found to have been completely effected. The purified malt wort is then passed through a bed of animal charcoal or any other suitable filtering medium to free it from the residuum or sediment, and it is then run into the boiling vessel to be boiled with the requisite proportion of hops as usual. The hopped wort is then cooled and conveyed into the fermenting vessel to be fermented by itself, if it is intended to make beer from malt alone, or it is conveyed into a collecting or fermenting vessel to be mixed and fermented together with maize wort, as hereinafter described. It will be understood that my object in submitting the malt flour to the action of phosphate of lime and sulphuric acid is to convert that portion of the starch which has not been acted upon during the process of malting into dextrine and saccharine.

The oleate of soda which I use with charcoals to neutralize the free acids, such as lactic, acetic, and ulmic acids, as well as the nitrogenous acrid and empyreumatic matters, I obtain by the well known process of combining soda and lime with almond oil or pistachio oil, or olive oil or arachidic oil.

In preparing the maize wort, the twenty bushels of maize are ground into flour, and the bran or husk having been removed therefrom, the said flour is put into the feeding hopper. Next I put into the mixing vessel or mashing tun the requisite proportion of water (about five hundred gallons) for obtaining ten barrels of beer, which water is heated by means of steam through an ordinary coil. I then add to the water about five pounds of phosphate of lime, and five pounds of pulverized charcoal diluted in four gallons of water, and five pounds of sulphuric acid, and five pounds of oxalic acid diluted in four gallons of water, putting at the same time the stirrer in motion for mixing the said mixture. It is to be noted that the proportions of the acids may be somewhat varied, and equivalent acids may in some cases be employed.

When the temperature has risen to 100° Fahrenheit, the maize flour is then gradually allowed to enter from the feeding hopper and is well mixed, the stirring and heating being continued until the temperature has risen to 212° Fahrenheit. The whole of the mixture is then introduced into a closed boiler or converter and boiled until the temperature in the said mixture has risen to from 250° to 300° Fahrenheit (equivalent to from forty to eighty pounds pressure to the square inch) according to the proportion of dextrine and fermentable saccharine, it is desired to obtain. The saccharified solution or wort is then drawn off and passed through any suitable strainer to free it from the residuum or grains, and it is then run into the purifying vessel, in which the process of neutralizing the sulphuric and oxalic acids as well as the free acids, such as lactic, acetic, and ulmic acids, and the nitrogenous acrid and empyreumatic matters contained in the wort is effected. For this purpose about fifteen pounds of carbonate of lime diluted in two gallons of water are added to the wort and thoroughly mixed with it for about a quarter of an hour, and then a compound of one pound of oleate of soda, one pound of pulverized wood charcoal, and one pound of pulverized animal charcoal is added to the wort, and likewise thoroughly mixed with it for another quarter of an hour, after which the neutralization and purification will be found to be effected. The purified wort is then passed through a bed of charcoal or any other suitable filtering medium to free it from sediment or other objectionable matter, and it is then conveyed into the boiling vessel to be boiled with the requisite proportion of hops, as usual. The hopped wort is then cooled and conveyed into the collecting or fermenting vessel containing the malt wort, or malt and sugar wort to be mixed and fermented therewith. It will be obvious that the proportion of malt wort or malt and sugar wort used may vary according to the judgment of the brewer.

It is sometimes the custom to macerate and infuse the hops, in that case the extract or produce of such maceration or infusion can be added to the worts either in the boiler or cooler or fermenting vessel.

I may here remark that by subjecting the maize flour to the combined action of phosphate of lime and sulphuric acid, as above explained, I am enabled to convert the whole of the starch into dextrine and fermentable saccharine, and that by treating the wort with oleate of soda, wood, and animal charcoal, I am enabled to remove from it the lactic, acetic, and ulmic acids, as well as the nitrogenous acrid and empyreumatic matters, the presence of which has hitherto rendered maize worts of little or no service to the brewer.

When manufacturing beer mainly from maize or equivalent wort, I proceed and conduct the process in the same manner as just above described for the preparation of maize wort, with the exception that when the wort has been saccharified, neutralized, purified, and passed through a bed of charcoal or other suitable filtering medium to free it from any sediment or other objectionable matter, it is conveyed into the boiling vessel, and there flavoured by the addition of malt flour thereto. The proportion of malt flour to the maize flour which I have found sufficient for this purpose is about five to twenty per cent., but a larger proportion may be used if thought desirable. The mixture of maize wort and malt flour is then heated to about 165 degrees to 170 degrees Fahrenheit, and kept at that temperature (stirring the whole time), until the conversion of the malt into the desired proportion of dextrine and fermentable saccharine is effected. The requisite proportion of hops is then added, and the whole of the mixture is allowed to boil as usual for from one to two hours. The boiled wort is then passed through the hop strainer, and cooled and fermented as usual.

I would observe that the flavoring malt flour and hops instead of being applied at this stage of the process, may if desired be introduced wholly or in part into the closed converter, where they will be subjected to the action of the agents already introduced, as above mentioned, *videlicet*, phosphate of lime, sulphuric and oxalic acids under a high temperature, as above described, by means of which nearly the whole of the flavoring properties of the malt and hops will be imparted to the wort. Or the malt, flour, and hops may be introduced wholly or in part into the purifying vessel during the process of neutralization and purification of the wort by means of the chemical agents above mentioned. Or the malt flour and hops may be introduced into the fermenting vessel, where the chemical action which takes place will extract from them their full flavor.

hops

In any case it will be beneficial to use from one to ten pounds of malt flour for every barrel of wort (whether obtained from malt, maize, or other substances above mentioned) in the fermenting vessel, as thereby a better and sounder fermentation and a larger production of yeast will be obtained.

In manufacturing stout, porter, and other highly colored beer I proceed and conduct the process in the same manner as for the production of maize beer, as above described, and I add to the mixture of maize flour water and chemicals, the materials required for giving colour to the wort. Thus I add to the mixture in the mixing vat about from five to ten pounds of pulverised roasted malt, and from four to sixteen ounces of American potash or pearl ash, diluted in about one gallon of water for the purpose of imparting colour and flavour to the wort. When the whole is well mixed and the temperature in the mixing vessel has risen to 212 degrees Fahrenheit, the wort is introduced into the converting apparatus, and boiled until the temperature of the said mixture has risen to from 250 degrees to 300 degrees Fahrenheit, which high temperature is maintained until the desired flavour and dark colour of the wort are obtained. The coloured wort is then drawn off, neutralized, purified, boiled with hops, cooled and fermented, as above described.

It should be remarked that the roasted malt may be introduced into the liquor at any one of the stages above indicated for introducing the malt flour and the hops, and for the same reason, *videlicet*, that all the flavouring constituents of the roasted malt will through the action of the chemical agents in the liquor, or by the fermenting process (as the case may be) be thoroughly extracted, thereby requiring a much less quantity of roasted malt to obtain the required degree of flavour and color.

Having now described the nature and object of my Invention, and the manner in which the same is to be performed, I wish it to be understood that I do not confine myself to the exact proportions of materials hereinbefore given, as they may be modified and varied within certain limits according to their nature and quality, without departing from the main principles of my improvements, nor do I confine myself to the use of the machinery herein mentioned, such machinery being often used by millers, brewers, distillers, and starch manufacturers, nor do I claim the removal of the husk from the malt nor from maize, but that which I claim under the above in part recited Letters Patent is,—

First. The production of ale, stout, porter, or like fermented liquors from malt worts mixed with worts made from either maize, rice, barley, big, oats, wheat, darn, millet, sago, mandioca, potatoes, arrowroot, or equivalent substances, such worts being separately prepared and treated so as to effect the removal of noxious ingredients therefrom, and subsequently mixed and fermented together, substantially as herein described.

Secondly. In the manufacture of ale, stout, porter, or the like fermented liquors the use, substantially as herein described, of worts made from maize, rice, barley, big, oats, wheat, darn, millet, sago, mandioca, potatoes, arrowroot, and the like, as a main substitute for malt, such worts being treated so as to effect saccharification and also the removal of the lactic, acetic, and ulmic acids, as well as the nitrogenous acrid and empyreumatic matters contained therein in the manner above set forth.

Thirdly. The improved process employed by me for effecting the required complete saccharification of the starchy matters contained either in barley, malt, or in maize or the like by heating such matters with chemical agents, substantially as herein described.

Fourthly. The improved process employed by me for effecting the requisite purification of the wort obtained from malt or from maize or the like by the aid of chemical agents, substantially at herein described.

Fifthly. The use as herein described of malt, flour, hops, and roasted malt subjected to the action of high heat varying from 250° to 300° Fahrenheit, at which temperature nearly the whole of the flavoring properties of the malt and hops are given out and may be imparted to the maize worts, substantially in the manner set forth.

Sixthly. The improved process of imparting colour and flavour to stout, porter, and like colored beers, by the use of potash or pearl ash, substantially as herein described.

Seventhly. The use of malt flour in the fermenting vessel, in the manner and for the purpose substantially as described.

In witness whereof, I, the said Alexandre Manbré, have hereto set my hand and seal, this Third day of August, in the year of our Lord One thousand eight hundred and eighty one.

ALEXANDRE MANBRÉ. (L.S.)

Witness,
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